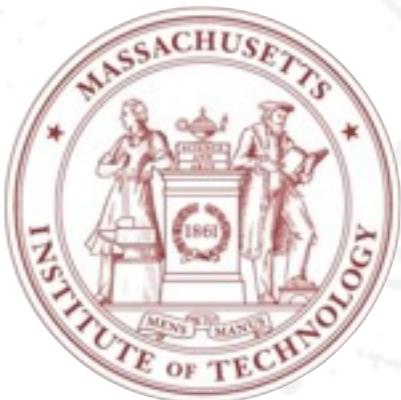


Top Quark Asymmetry @ LHCb

Mike Williams

**Department of Physics & Laboratory for Nuclear Science
Massachusetts Institute of Technology**

**“Snowmass” @ BNL
April 5, 2013**

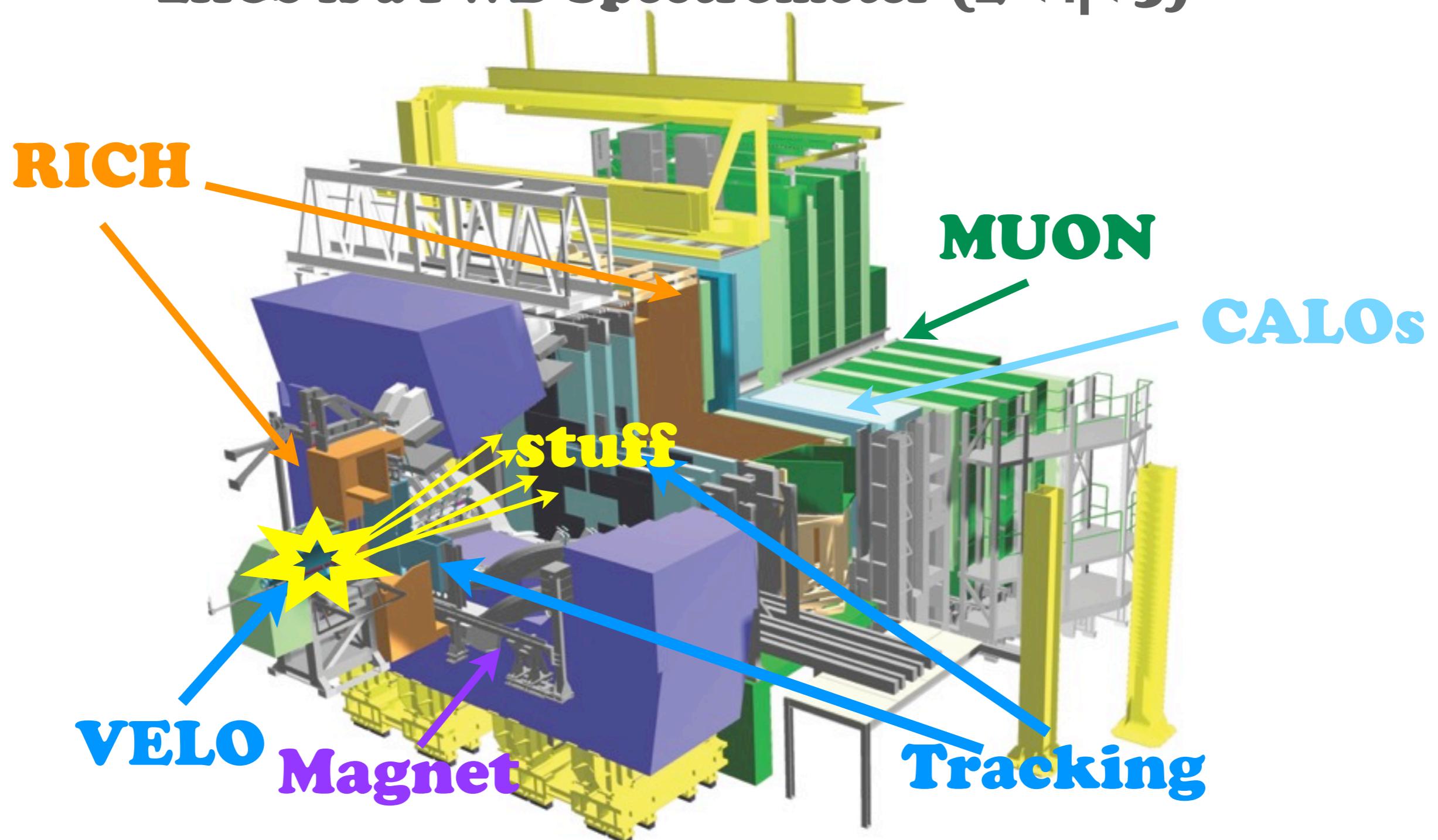




The LHCb Experiment



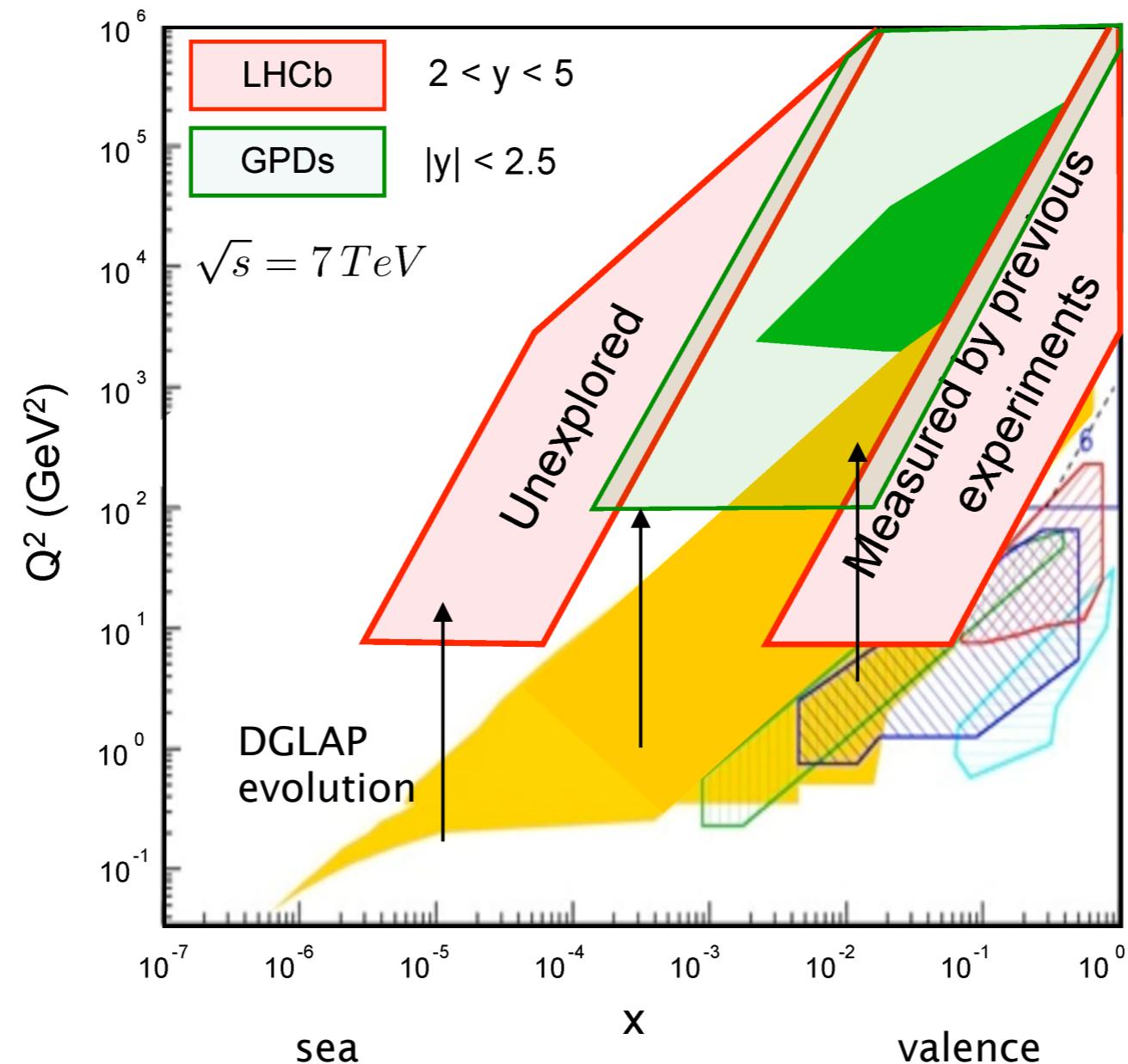
LHCb is a FWD Spectrometer ($2 < \eta < 5$)



It was built to study rare and CP-violating b and c decays.



LHCb collisions are one high-x and one low-x parton.



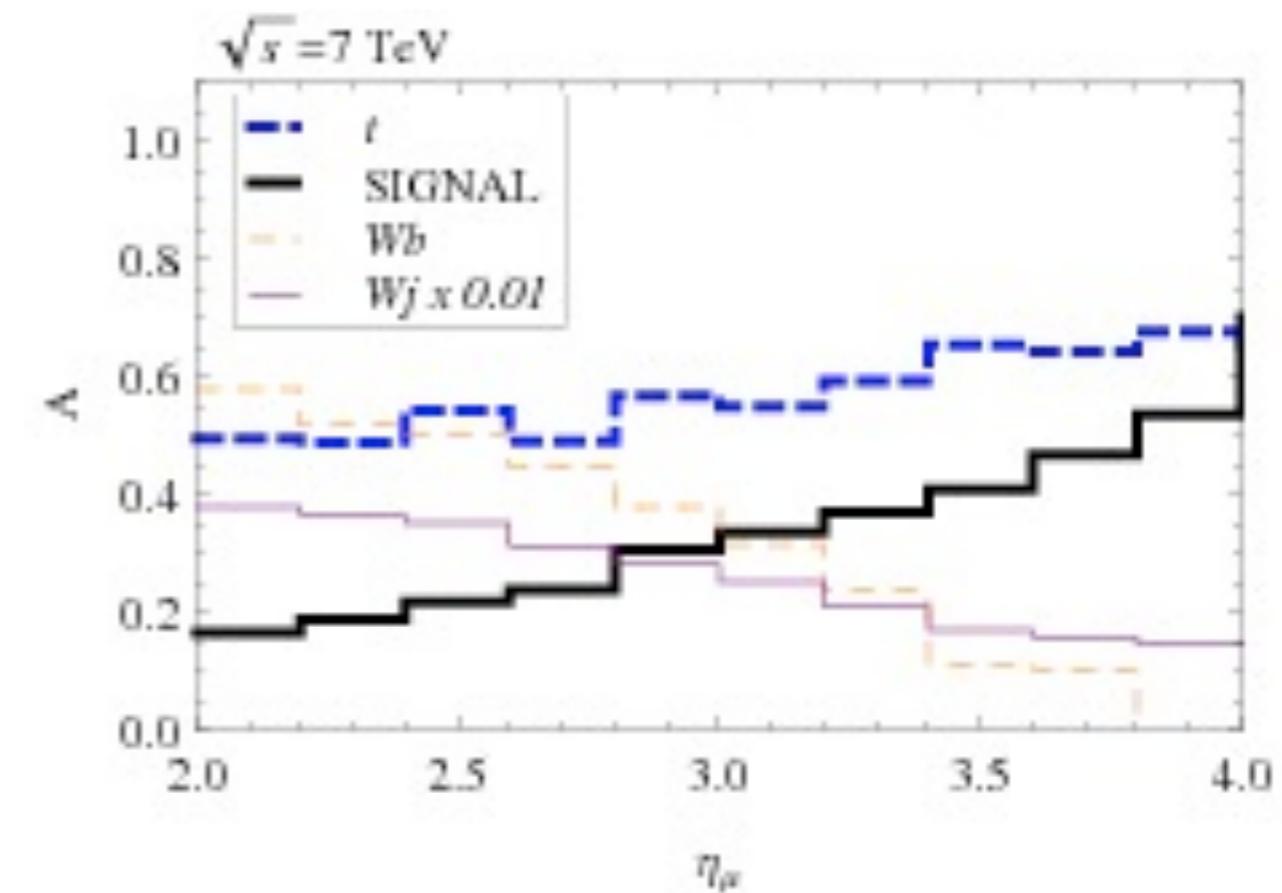
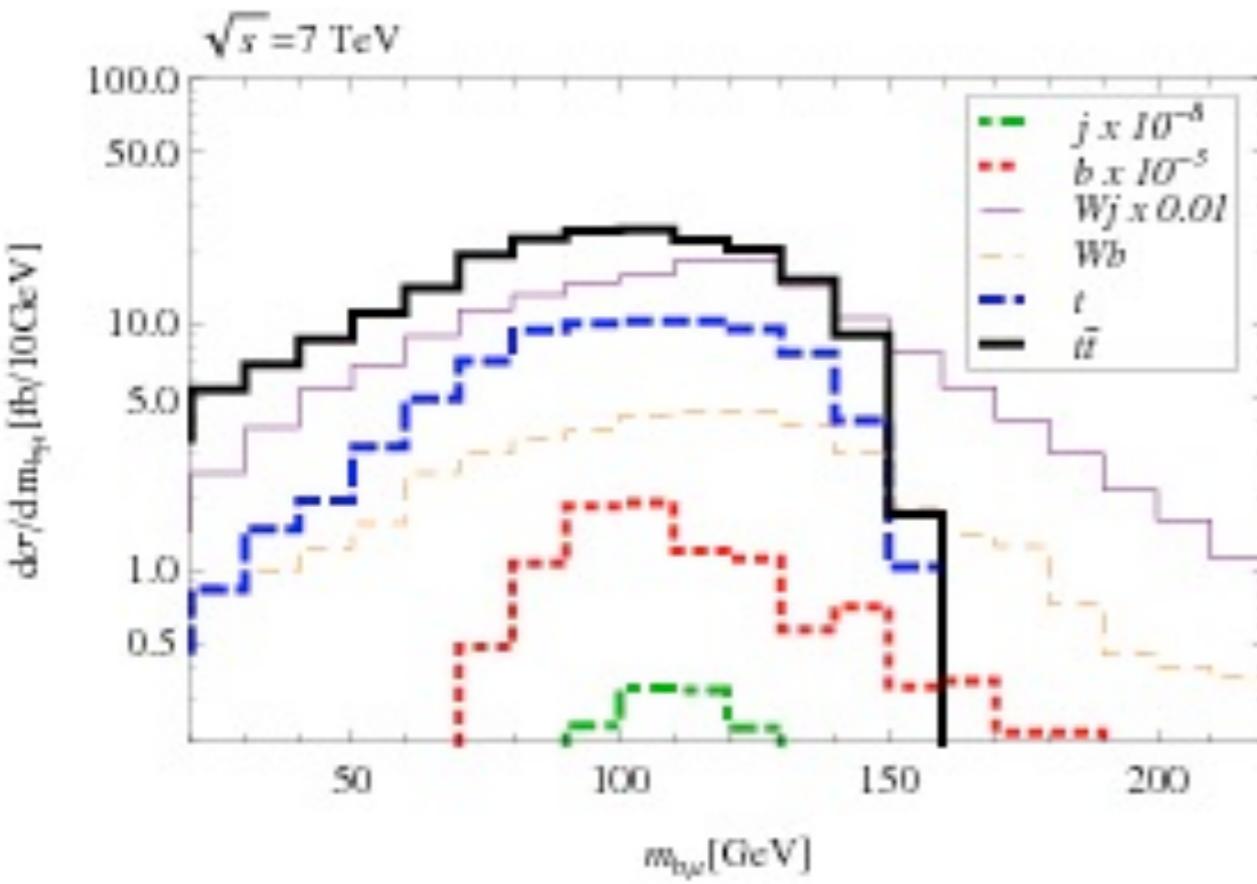
Small overlap with ATLAS/CMS for $2 < y < 2.5$.



Top Asymmetry



Kagan, Kamenik, Perez, Stone, PRL 107, 082003 (2011) [arXiv:1103.3747]



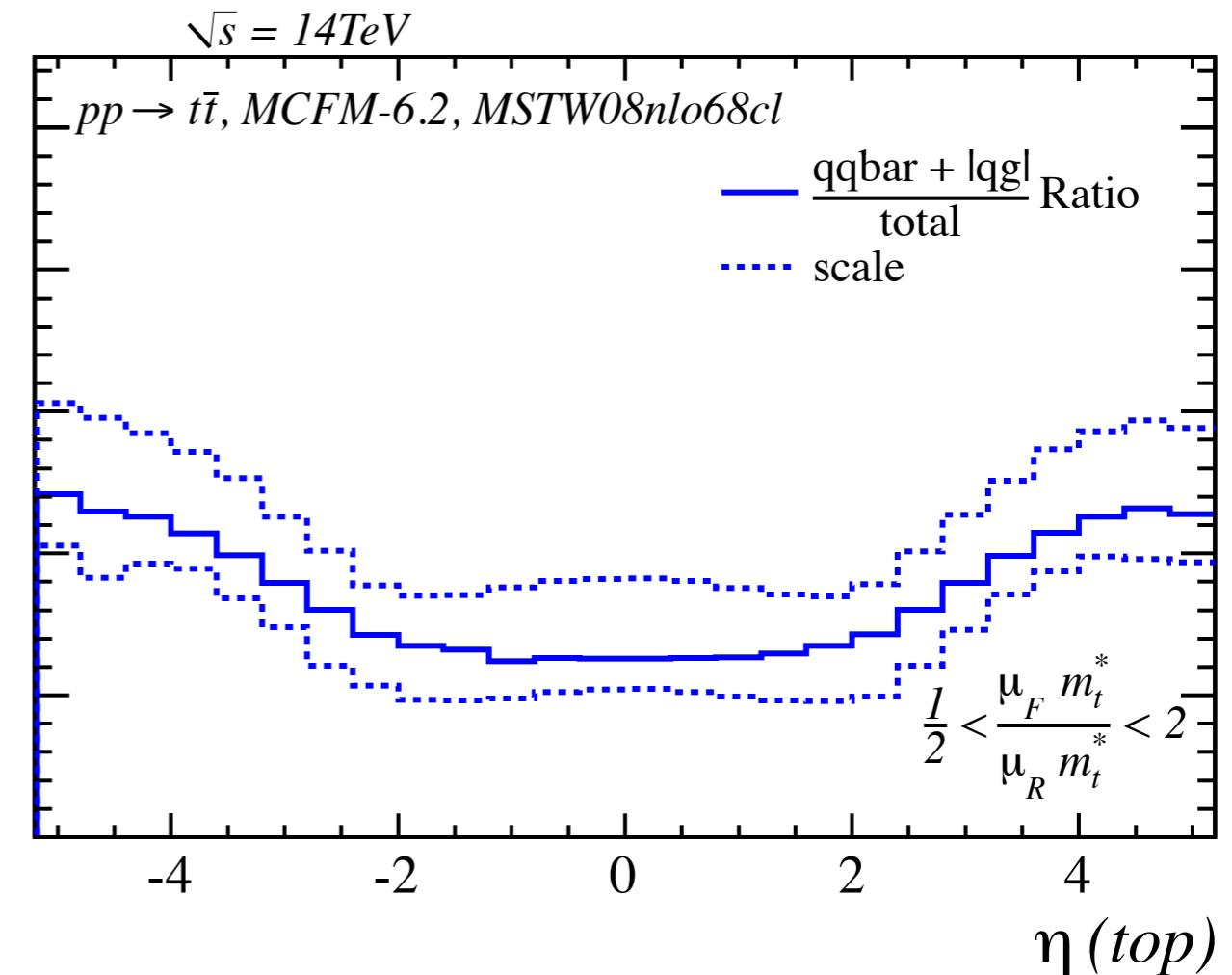
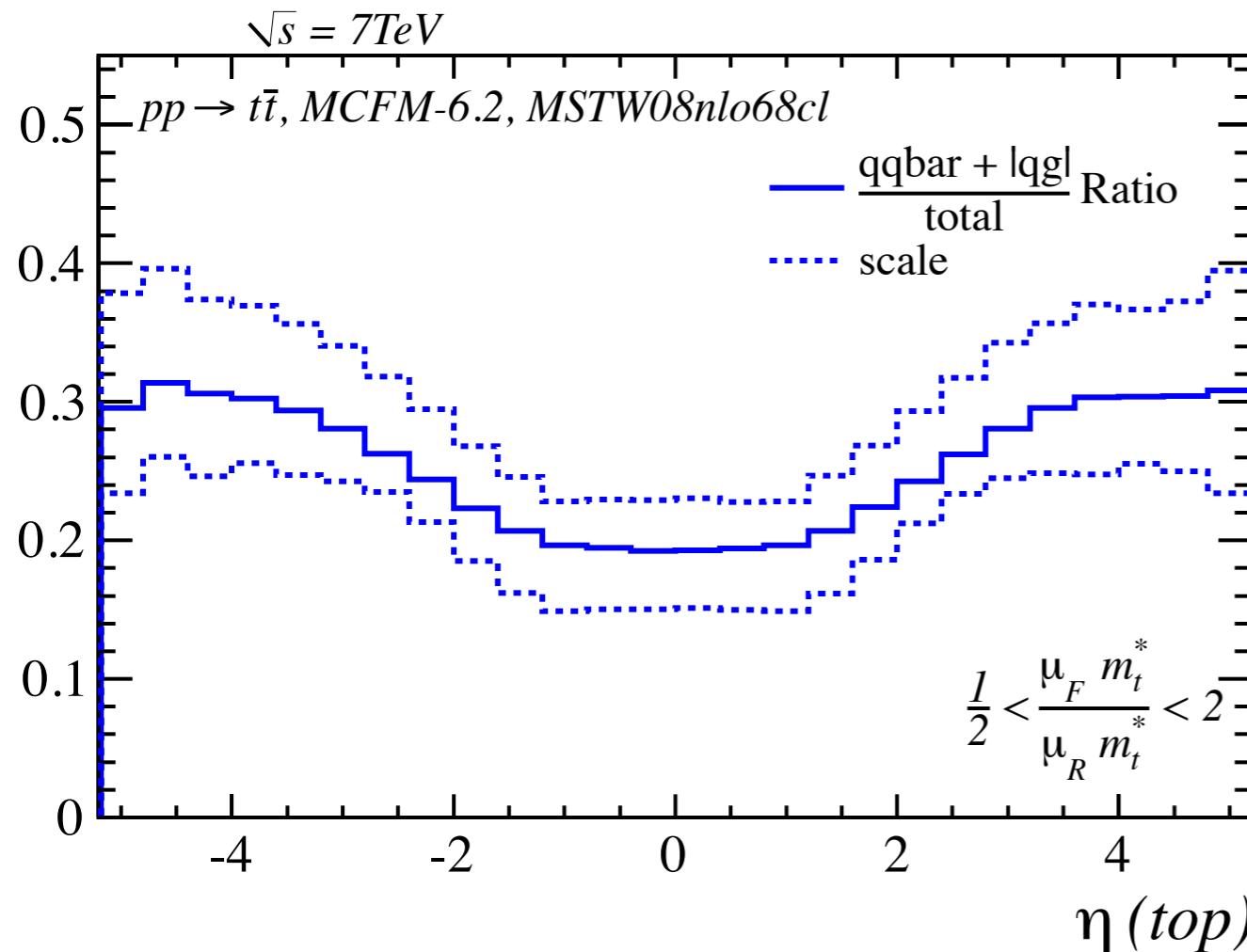
“LHCb may be able to measure a $t\bar{t}$ production rate asymmetry, and thus indirectly probe an anomalous forward backward $t\bar{t}$ asymmetry in the forward region”



Top Asymmetry



LHC \bar{b} NLO study using MCFM



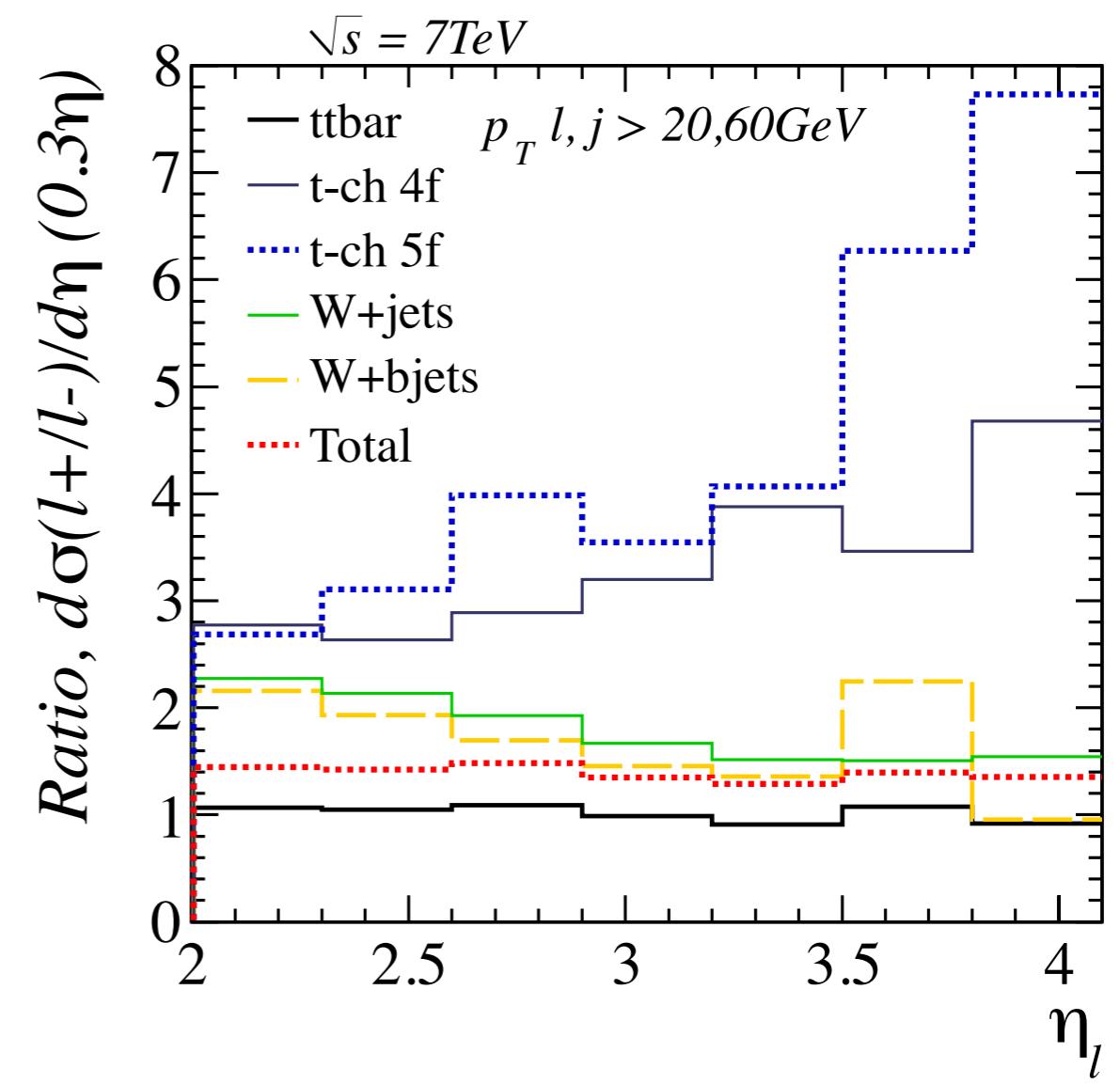
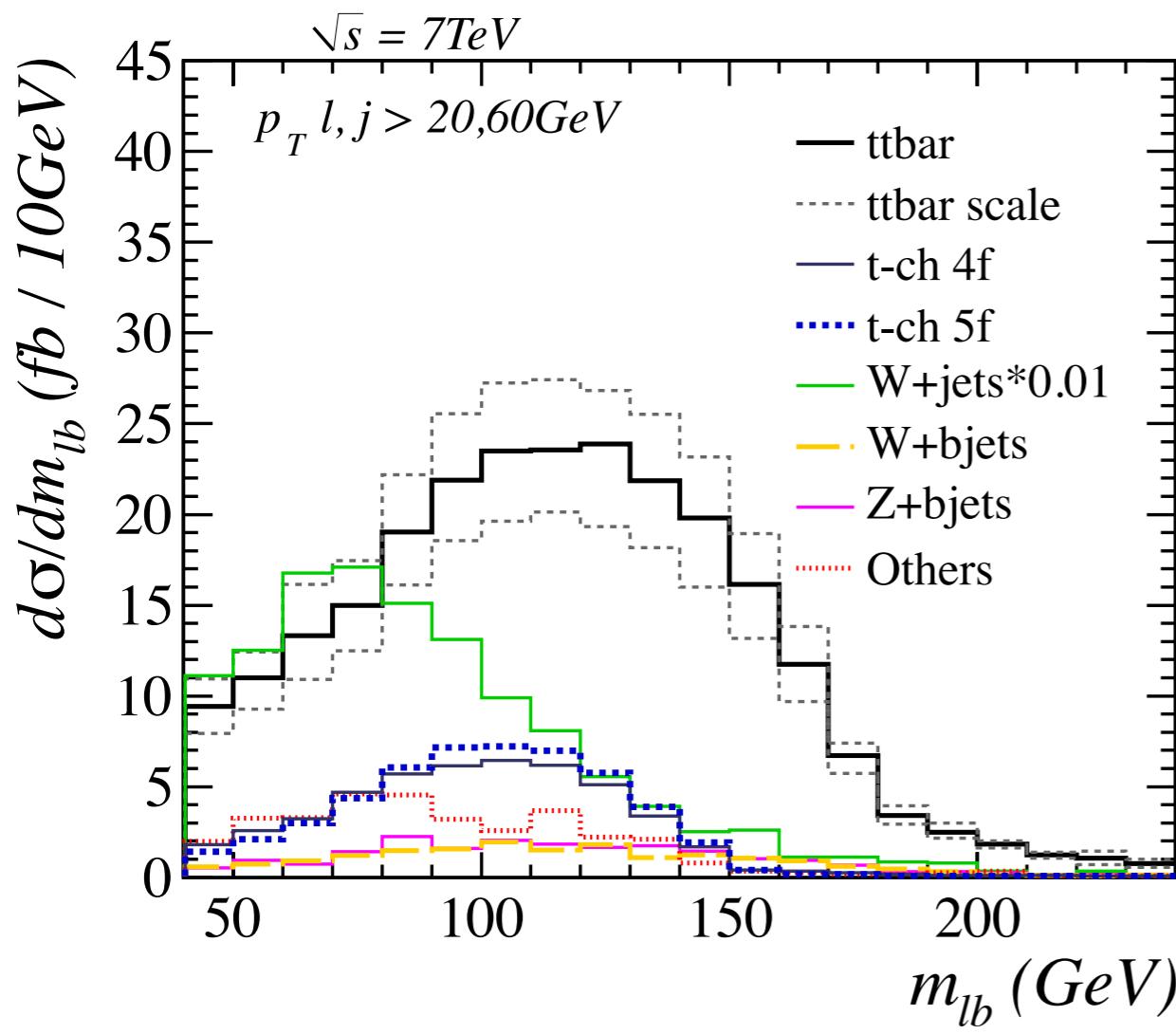
Large y region is more sensitive to the charge asymmetry.



Top Asymmetry



LHCb NLO study using POWHEG + Pythia8



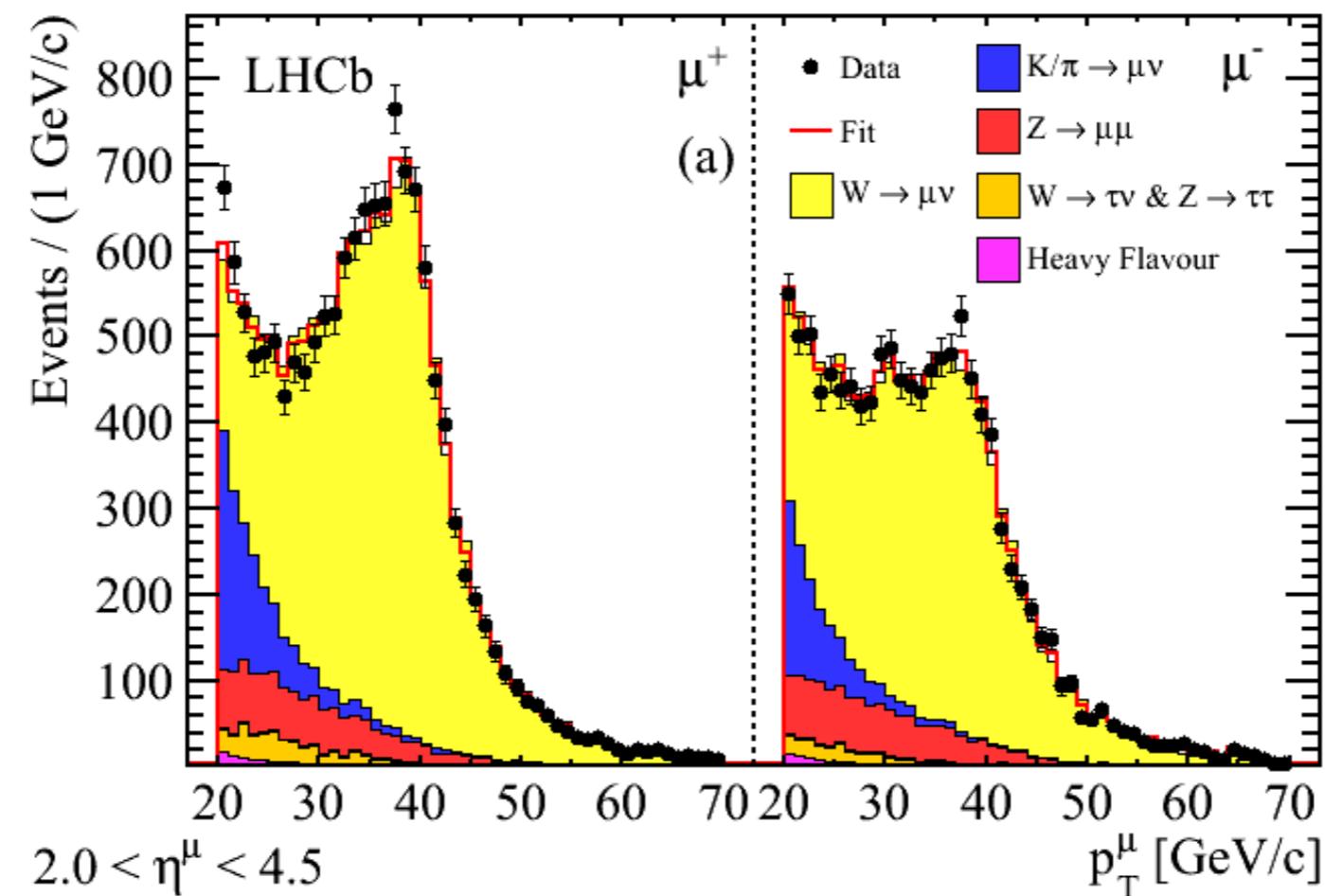
Predicted asymmetry @ LHCb is ~1% for 1b.



W Selection



W production @ LHCb, JHEP 06, 058 (2012) [arXiv:1204:1620]



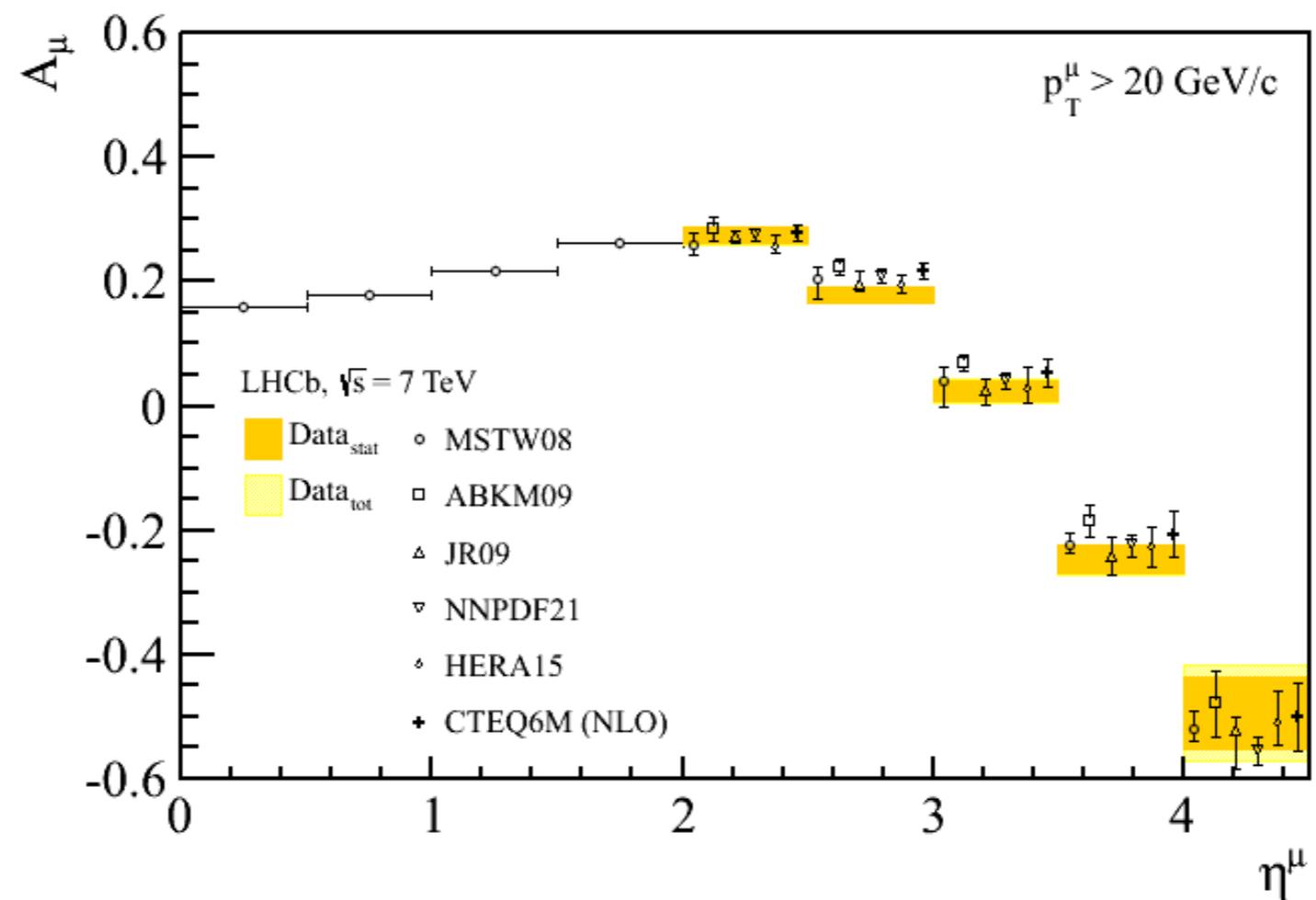
Missing ET not possible @ LHCb. W yield from fit to lepton PT.



W Selection

LHCb
ГИСР

W production @ LHCb, JHEP 06, 058 (2012) [arXiv:1204:1620]



Observed lepton charge asymmetry agrees well with predictions.

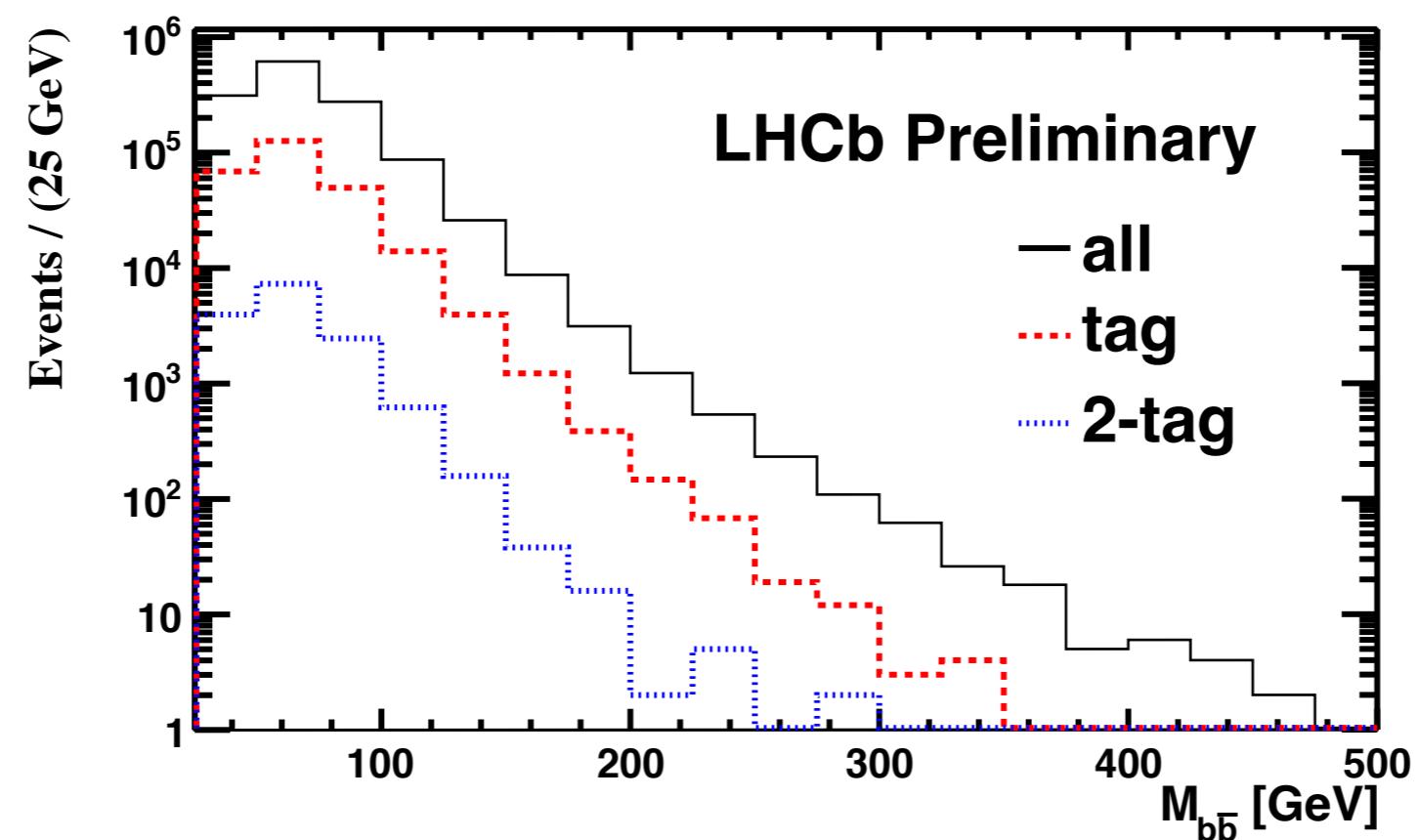


Beauty Asymmetry



Kahawala, Krohn, Strassler, JHEP, 69 (2012) [arXiv:1108.3301]: The beauty AFC could be used to search for similar effects as seen in AFB in truth.

LHCb-CONF-2013-001: 2 b jets, back-to-back, 2011 data only.



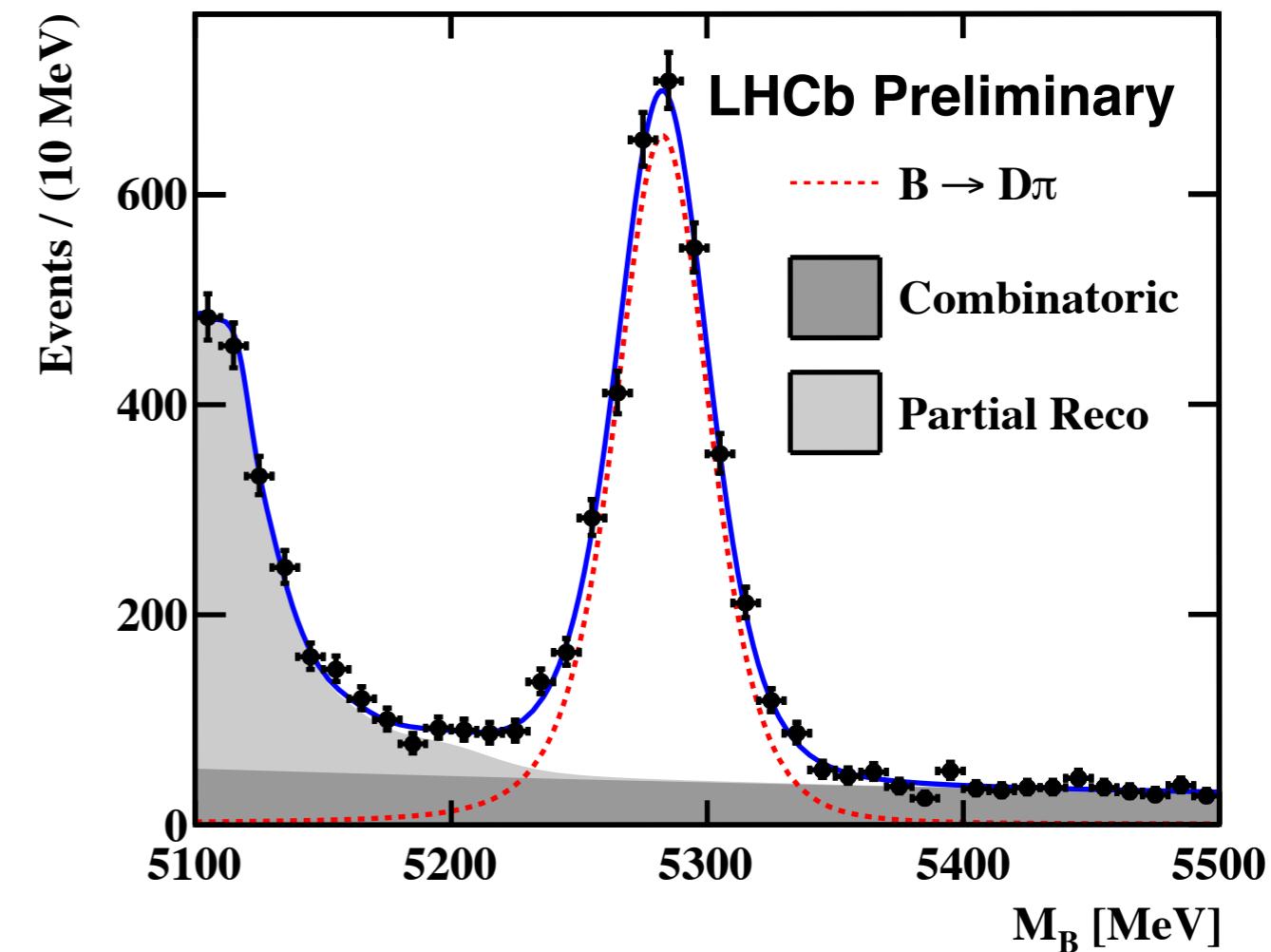
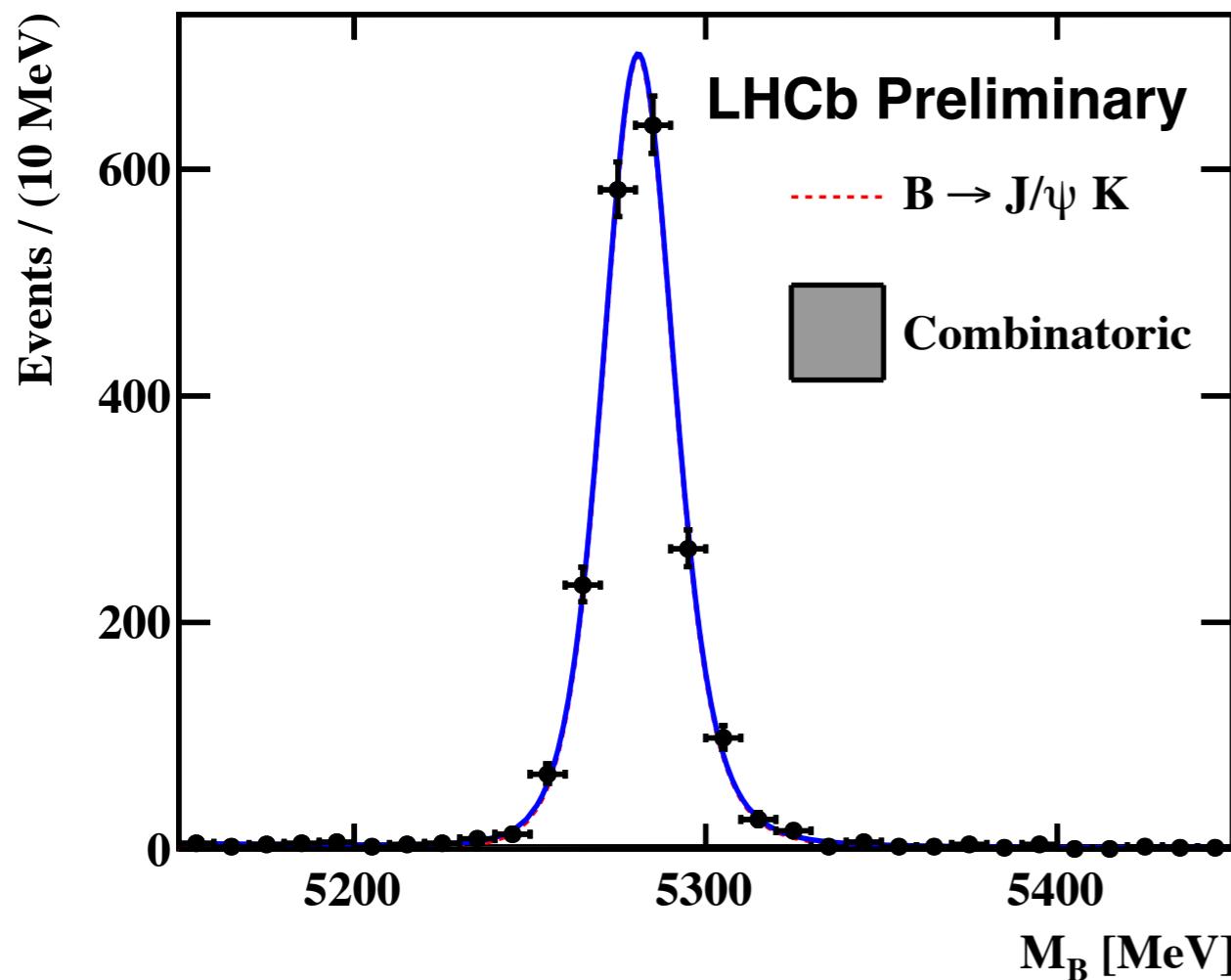
The b tag is our HLT BDT (on both jets). The flavor tag requires the hardest, displaced track in the jet is a muon. Resolution on $M_{b\bar{b}}$ is (15-20)%.



Beauty Asymmetry



Flavor-Tagging Purity (predicted to be $73 \pm 2\%$)



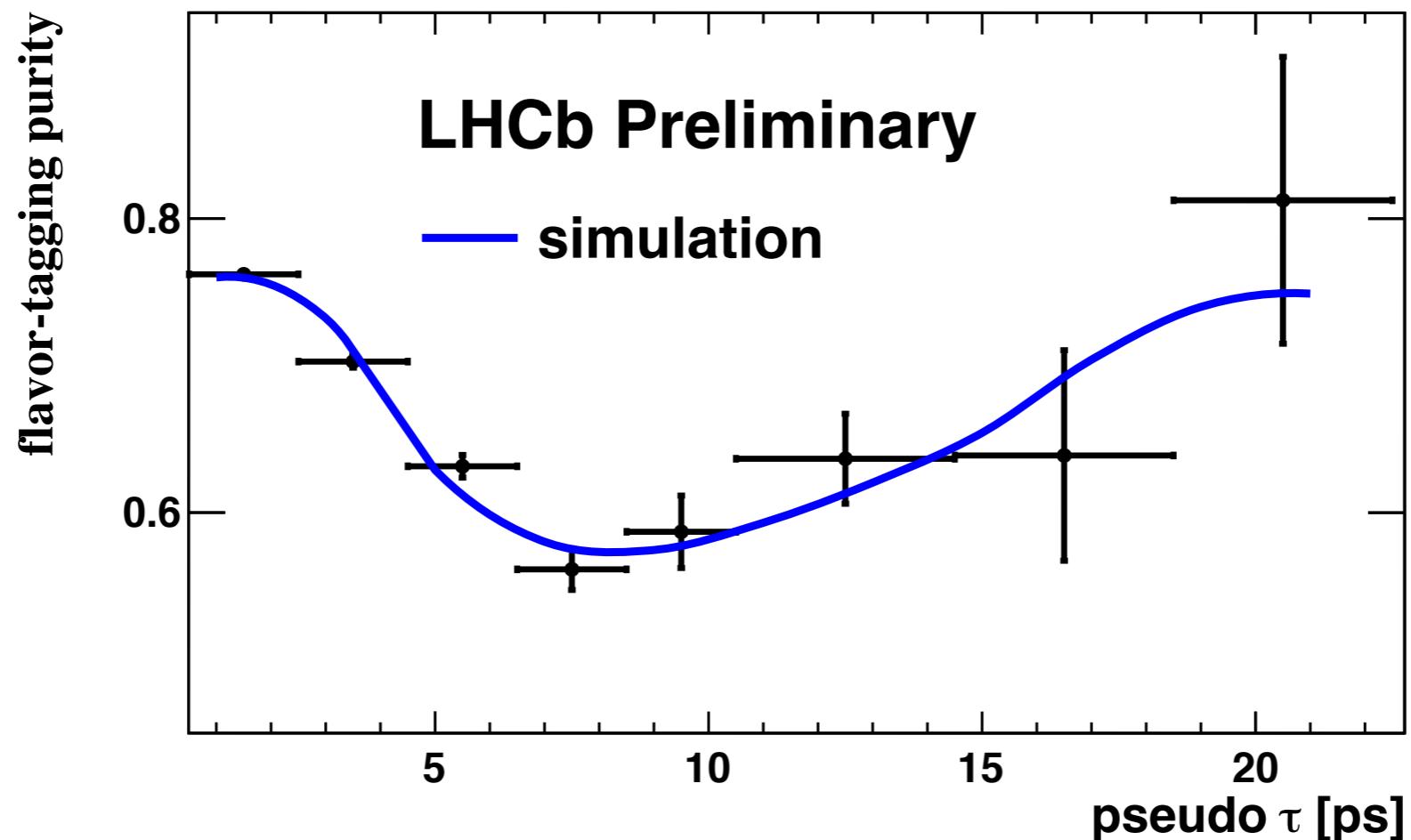
Fully RECO one b in flavor-tagging decay to check flavor tag on the other b. Purity = $(71.5 \pm 4.0)\%$.



Beauty Asymmetry



Flavor-Tagging Purity (predicted to be $73 \pm 2\%$)



Purity measured in doubly-tagged jet events to be $(70.7 \pm 0.4\%)$; time-dependence agrees with simulation.

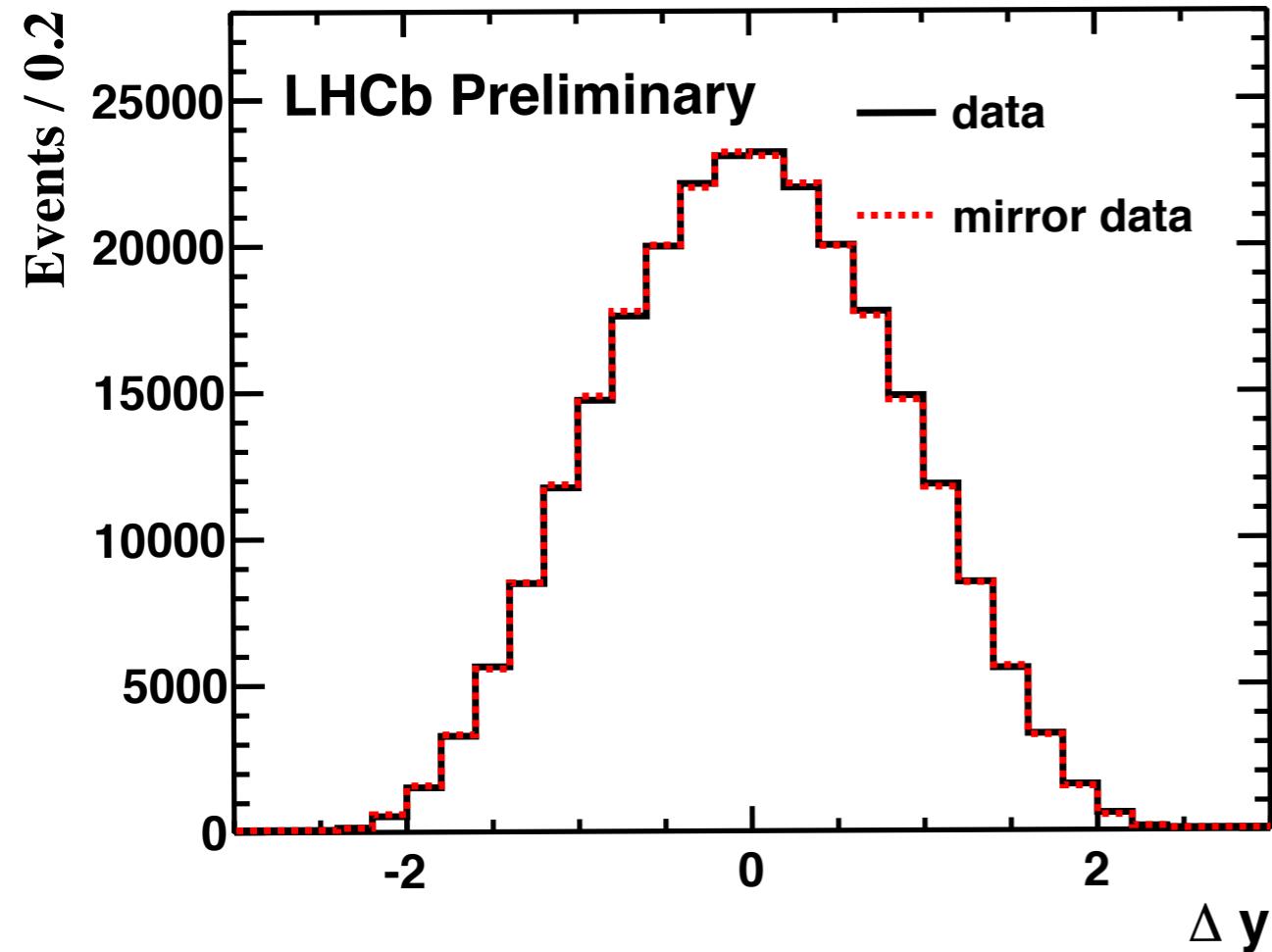


Beauty Asymmetry

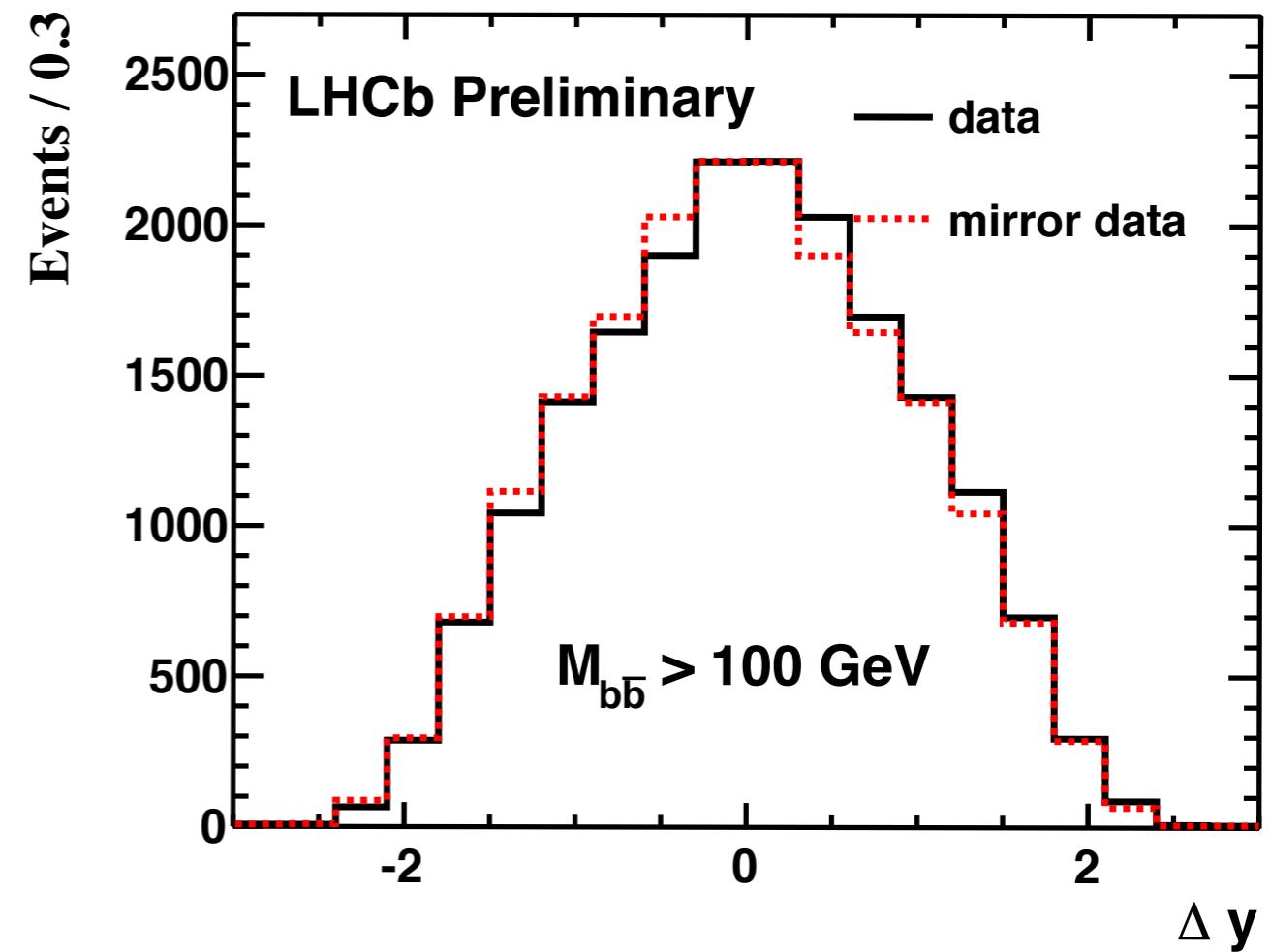
LHCb
THCP

“Raw” Delta y

all



M_{b̄b} > 100 GeV



AFC Results

(0.5±0.5±0.5)%

(4.3±1.7±2.4)%

Improved analysis that also includes 2012 data soon.



Summary



- LHCb has complementary rapidity coverage to ATLAS and CMS.
- Measuring the top rate asymmetry @ LHCb could indirectly probe top AFB physics.
- W yields measured precisely w/o missing ET.
- LHCb b jet performance is good (and improving); our beauty AFC analysis is a prototype for the top measurements.
- Work now is focused on top RECO & cross sections. Moving towards real measurement.

Back Up



W Selection



Muon: $20 < p_T < 70 \text{ GeV}/c$, $2.0 < \eta < 4.5$

**Isolation: $E_T^{\text{cone}} < 2 \text{ GeV}$, $p_T^{\text{cone}} < 2 \text{ GeV}/c$
(Cone R < 0.5 around muon)**

**Cuts against background:
from semileptonic decays of heavy flavour
Impact parameter < 40 micron**

γ^*/Z : No other muon with $p_T > 2 \text{ GeV}/c$

K/ π punch through: $E(\text{Calorimeter})/pc < 0.04$



b Jets



- **anti-Kt ($R=0.5$)**
- **$pT > 15 \text{ GeV}$ (each jet)**
- **Delta phi > 2.5**
- **b-tag uses 2, 3, and 4-body displaced vertices and a BDT to select b's. BDT uses scalar sum PT, min PT, “corrected” mass, max DOCA, FD chi₂, IP chi₂.**